

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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Pearson Edexcel International Advanced Level

Time 1 hour 30 minutes

Paper

reference

WME02/01

Mathematics

International Advanced Subsidiary/Advanced Level Mechanics M2

You must have:

Mathematical Formulae and Statistical Tables (Yellow), calculator

Total Marks

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Whenever a numerical value of g is required, take $g = 9.8 \text{ m s}^{-2}$, and give your answer to either 2 significant figures or 3 significant figures.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 7 questions in this question paper. The total mark for this paper is 75.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ►

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Pearson

Question 1 continued

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Q1

(Total 8 marks)



- (5)

(4)

Question 2 continued

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Question 2 continued

Lined area for writing the answer to Question 2.



Question 2 continued

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Q2

(Total 9 marks)



- At time t seconds ($t \geq 0$), the velocity v m s^{-1} of P is given by

$$\mathbf{v} = (6 \sin 3t)\mathbf{i} + (1 + 2 \cos t)\mathbf{j}$$

- (a) Find $\mathbf{F}$ in terms of t .

(3)

At time $t = 0$, the position vector of P relative to a fixed point O is $(4\mathbf{i} - \sqrt{3}\mathbf{j})\text{ m}$.

- (b) Find the position vector of P relative to O when P is first moving parallel to the vector $\mathbf{i}$.

(6)

Question 3 continued

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Question 3 continued

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Question 3 continued

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Q3

(Total 9 marks)



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- (b) Find the range of possible values of e . (4)

Question 4 continued

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Question 4 continued

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Question 4 continued

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(Total 10 marks)

Q4



5.

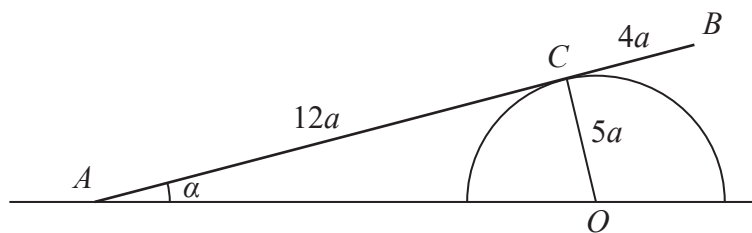


Figure 1

A smooth solid hemisphere is fixed with its flat surface in contact with rough horizontal ground. The hemisphere has centre O and radius $5a$.

A uniform rod AB , of length $16a$ and weight W , rests in equilibrium on the hemisphere with end A on the ground. The rod rests on the hemisphere at the point C , where $AC = 12a$ and angle $CAO = \alpha$, as shown in Figure 1.

Points A , C , B and O all lie in the same vertical plane.

- (a) Explain why $AO = 13a$ (1)

The normal reaction on the rod at C has magnitude kW

- (b) Show that $k = \frac{8}{13}$ (3)

The resultant force acting on the rod at A has magnitude R and acts upwards at θ° to the horizontal.

- (c) Find
- (i) an expression for R in terms of W
- (ii) the value of θ (8)



Question 5 continued

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Question 5 continued

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Question 5 continued

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Q5

(Total 12 marks)



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6. [The centre of mass of a semicircular arc of radius r is $\frac{2r}{\pi}$ from the centre.]

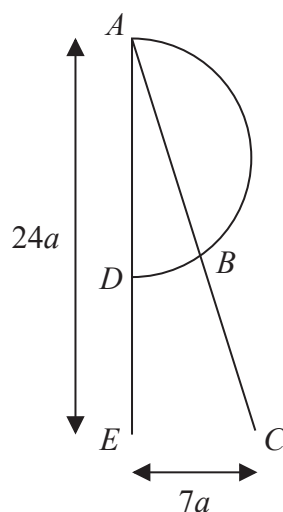


Figure 2

Uniform wire is used to form the framework shown in Figure 2.

In the framework,

- ABC is straight and has length $25a$
- ADE is straight and has length $24a$
- ABD is a semicircular arc of radius $7a$
- $EC = 7a$
- angle $AEC = 90^\circ$
- the points A, B, C, D and E all lie in the same plane

The distance of the centre of mass of the framework from AE is d .

- (a) Show that $d = \frac{53}{2(7 + \pi)}a$ (4)

The framework is freely suspended from A and hangs in equilibrium with AC at angle α° to the downward vertical.

- (b) Find the value of α . (7)



Question 6 continued

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Question 6 continued

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Question 6 continued

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(Total 11 marks)

Q6



7. A particle P is projected from a fixed point O on horizontal ground. The particle is projected with speed u at an angle α above the horizontal. At the instant when the horizontal distance of P from O is x , the vertical distance of P above the ground is y . The motion of P is modelled as that of a particle moving freely under gravity.

(a) Show that $y = x \tan \alpha - \frac{gx^2}{2u^2} (1 + \tan^2 \alpha)$ (6)

A small ball is projected from the fixed point O on horizontal ground. The ball is projected with speed 20 m s^{-1} at angle θ° above the horizontal. A vertical pole AB , of height 2 m , stands on the ground with $OA = 10 \text{ m}$, as shown in Figure 3.

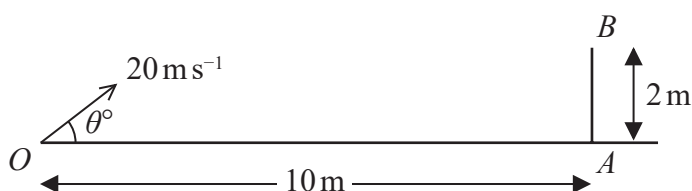


Figure 3

The ball is modelled as a particle moving freely under gravity and the pole is modelled as a rod.

The path of the ball lies in the vertical plane containing O , A and B .

Using the model,

- (b) find the range of values of θ for which the ball will pass over the pole. (3)

Given that $\theta = 40^\circ$ and that the ball first hits the ground at the point C

- (c) find the speed of the ball at the instant it passes over the pole, (5)

- (d) find the distance OC . (2)



Question 7 continued

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Question 7 continued

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Question 7 continued

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Question 7 continued

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Q7

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(Total 16 marks)

TOTAL FOR PAPER IS 75 MARKS

END

